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United States
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Dividends From Wood Research

Recent Publications

January–June 1993

Explanation and Instructions

"Dividends From Wood Research" is a semiannual listing of recent publications resulting from wood utilization research at the Forest Products Laboratory (FPL). These publications are produced to encourage and facilitate application of Forest Service research. This issue lists publications received from the printer between January 1 and June 30, 1993.

Each publication listed in this brochure is available through at least one of the following sources.

Available from FPL (indicated by an order number before the title of the publication): Quantities limited. Circle the order number on the blank at the end of the brochure and mail or FAX the blank to FPL.

Available through sales outlets (indicated by the name of the outlet and, when available, price information): Major sales outlets are the Superintendent of Documents, the National Technical Information Service (NTIS), and various private publishers. Order directly from the outlet.

Available through libraries: Research publications are available through many public and university libraries in the United States and elsewhere. U.S. Government publications are also available through many Government Depository Libraries. Check with a major library near you to determine availability.

List of Categories

Publications are listed in this brochure within the following general categories:

- Anatomy and Identification
- Biodeterioration and Protection
- Energy
- Engineering Properties and Design Criteria
- Fiber and Particle Products
- Fire Safety
- Microbial and Biochemical Technology
- Mycology
- Processing of Wood Products
- Pulp, Paper, and Packaging
- Timber Requirements and Economics
- Tropical Wood Utilization
- Wood Bonding Systems

Anatomy and Identification

1. Wood Anatomy of Tecomeae

Dos Santos, Graciela; Miller, Regis B.
1992. In: *Flora Neotropica*. Monograph 25(II).
Bignoniaceae—Part II. (Tribe Tecomeae). New York: The
New York Botanical Garden: 336–358.

In this chapter, the systematic wood anatomy of *Tabebuia* and its close relatives in the tribe Tecomeae and the potential application of the data obtained to classify the group are discussed. Intra- and inter-generic relationships are assessed based on the wood anatomy data. An attempt is made to delimit groups of related taxa within *Tabebuia*.

Biodeterioration and Protection

**Proceedings of the International Research Group on
Wood Preservation. 24th annual meeting, 1993 May 16–
21, Orlando, FL. The Research Group on Wood
Preservation.**

*Available from IRG Secretariat, Box 5607, S-114 86
Stockholm, Sweden. Cost: About 150 Swedish crowns.*

**Biosynthesis of β -Glucan Microfibrils by Cellular
Fractions From Brown-Rot Fungus *Postia placenta*
(MAD-698 and ME-20) and White-Rot Fungus
Schizophyllum commune (MAD-619) by Croan, Suki
C.; Highley, Terry L. Doc. No. IRG/WP/93-10025.**

**Controlling the Sapstain Fungus *Ceratocystis*
coerulescens by Metabolites Obtained From
Bjerkandera adusta and *Talaromyces flavus* by
Croan, Suki C.; Highley, Terry L. Doc. No. IRG/WP/
93-10024.**

**The Role of Oxalic Acid in Short Fiber Formation
by the Brown-Rot Fungus *Postia placenta* by Green,
F. III; Hackney, J.M.; Clausen, C.A.; Larsen, M.J.;
Highley, T.L. Doc. No. IRG/WP/93-10028.**

**Thirty-Four Year Test of On-Site Preservative
Treatments to Control Decay in Wood Above
Ground by Highley, Terry L.; Scheffer, Theodore C.
Doc. No. IRG/WP/93-30015.**

Antagonistic Effect of *Trichoderma* spp. Against Basidiospores by Srinivasan, Usha; Highley, Terry L.; Croan, Suki C.; Bruce, Alan. Doc. No. IRG/WP/93-10027.

2. Characterization of Monoclonal Antibodies to Wood-Derived β -1,4-Xylanase of *Postia placenta* and Their Application to Detection of Incipient Decay

Clausen, C.A.; Green, F.; Highley, T.L.
1993. Wood Sci. Technol. 27: 219-228.

This paper reports the first successful attempt to produce murine monoclonal antibodies to xylanase of a brown-rot decay fungus isolated from wood, and their use in detection of incipient decay at low wood weight loss, i.e. less than 10 percent.

3. Natural Weathering of Wood and Its Control by Water-Repellent Preservatives

Feist, William C.
1992. Am. Paint. Contractor. 69(4): 18-25.

This article examines the weathering process that produces the natural look, and then considers the use of water-repellent preservatives to protect the surface and maintain a pleasing appearance.

4. Acid-Mediated Depolymerization of Cellulose During Incipient Brown-Rot Decay by *Postia placenta*

Green, F. III; Larsen, M.J.; Hackney, J.M.; Clausen, C.A.; Highley, T.L.
1992. In: Kuwahar, Masaaki; Shimada, Mikio, eds. Biotechnology in pulp and paper industry: Proceedings of 5th International conference on biotechnology in pulp and paper industry; 1992 May 27-30; Kyoto, Japan. Tokyo, Japan: Uni Publishers Co., Ltd. Chapter 42: 267-272.

Many authors have noted similarities between acid hydrolysis and brown-rot decay. However, acid conditions strong enough to hydrolyze wood components were considered unlikely. There is now renewed interest in the role of oxalic acid production as it relates to the mechanism of brown-rot decay. The relationship of oxalic acid to decreased pH and depolymerization of hemicellulose and cellulose during brown-rot decay by *Postia placenta* was recently examined. This examination supports the hypothesis of Jennison (1952) and others that the hydronium ion initiates and facilitates depolymerization of hemicelluloses and cellulose. This paper extends initial observations, in part, by inclusion of species of other taxonomic families of brown-rot fungi.

5. Hydroperoxidation in Photoirradiated Wood Surfaces

Hon, David N.-S.; Feist, William C.
1992. Wood Fiber Sci. 24(4): 448-455.

In this paper, the usefulness of a diffuse reflectance spectroscopy coupled with Fourier transform infrared spectroscopy to identify hydroperoxide product is demonstrated. The formation and decay of hydroperoxide are monitored by means of electron spin resonance spectroscopy.

6. Increase in Wettability of Wood With Weathering

Kalnins, Martins A.; Feist, William C.
1993. Forest Prod. J. 43(2): 55-57.

The objective of this study was to determine if outdoor weathering changed the wettability of western redcedar. A procedure that was developed recently for determining wettability of wood surfaces was well-suited for use with the panels in this research.

7. Suppression of Aerial Hyphae by Staling Products of *Postia placenta*

Micales, Jessie A.
1992. Int. Biodeterior. & Biodegrad. 30: 285-302.

The objective of this study was to grow a normal, floccose strain of *P. placenta*, designated MAD698, in the spent culture filtrate of ME20 to determine whether the production of aerial mycelia would be affected. Commercial enzyme preparations of laminarinase and protease were also used to assess the effect of excess levels of autolytic enzymes on the colony morphology and growth of MAD698.

8. Professional Finishing of CCA Pressure-Treated Wood

Ross, Alan; Bussjaeger, Steven; Carlson, Richard; Feist, William.
1992. Am. Paint. Contractor. 69(7): 107-114.

This article summarizes how to professionally finish CCA pressure-treated wood. It explains what pressure treatment does to wood, the grades and species of treated wood, the advantages and disadvantages of coating CCA-treated wood, and the various products available used to coat CCA-treated wood. In addition, suggestions on surface preparation and application of coatings for CCA-treated wood are given.

9. Durability of Paint or Solid-Color Stain Applied to Preweathered Wood

Williams, R. Sam; Feist, William C.
1993. Forest Prod. J. 43(1): 8-14.

This study reports on the effect of short-term preweathering of smooth western redcedar and roughsawn Douglas-fir on the service life of paints and film-forming opaque stains (solid-color stains) applied to these substrates after preweathering. The paint bond strength of matched specimens that were not weathered after painting was previously measured and reported. The service life of acrylic latex and oil-based paint on western redcedar is compared with those bond strengths.

Energy

10. Research on Combustion of Wood Containing Nonwood Materials

Baker, Andrew J.
1991. In: Suadicani, Kjell, ed. Proceedings of joint meeting; IEA/BEA Activity 4 and 5; 1991 June 12-14; Silsoe, Sweden. Denmark, Sweden: Danish Forest and Landscape Research Institute: 114-122.

This report first describes nonwood components in wood residue and sludge and then describes research in the United States related to the combustion of wood residue. The research studies are aimed at providing environmental regulators and project developers with the information necessary for informed decisions on the use of wood residue for fuel. The use of residue for fuel represents a potential solution to two major problems: the need for alternative energy production and the need for alternative waste disposal.

11. Wood Ash Composition as a Function of Furnace Temperature

Misra, Mahendra K.; Ragland, Kenneth W.; Baker, Andrew J.

1993. *Biomass Bioenergy*. 4(2): 103–116.

This paper presents results on the chemical composition of mineral matter in wood after heating the ash from five wood species: pine, aspen, white oak, red oak, and yellow-poplar, and two bark species (white oak and Douglas-fir). Results on the extent of mineral matter transformations with temperatures to 1400°C in air are discussed in context of ash deposition in boilers utilizing wood and wood waste as fuel.

Engineering Properties and Design Criteria

12. Solid-Sawn and Laminated Posts

Bohnhoff, D.R.; Moody, R.C.; Manbeck, H.B.

1992. In: Walker, John N.; Woeste, Frank E., eds. *Post-frame building design*. ASAE Monograph 11. St. Joseph, MI: American Society of Agricultural Engineers. Chapter 76: 105–137.

Posts are the main structural elements in the post-frame wall. All loads applied to a structure are eventually channeled through the posts to ground level. Although posts may be bolted to the top of a concrete frost wall or floating slab foundation, they are generally embedded in the soil. When embedded, the posts are bearing structure transfer load to the soil and thereby function as the foundation for the building. This chapter discusses the selection and design properties of two main categories of posts: solid-sawn and laminated.

Controlling Moisture in the Walls of Manufactured Housing

Burch, Douglas M.; TenWolde, Anton.

1992. NISTIR 4981. U.S. Department of Commerce Technology Administration National Institute of Standards and Technology. Gaithersburg, MD: Building and Fire Research Laboratory, National Institute of Standards and Technology: 2 p.

Available from National Institute of Standards and Technology, Room B320, Bldg. 226, Gaithersburg, MD 20899. No charge.

The National Institute of Standards and Technology recently developed a detailed model, MOIST, that predicts the combined transfer of heat and moisture in a multilayer wall under nonisothermal conditions. This model includes moisture transfer by diffusion and capillary flow. The moisture-transfer resistance offered by vapor retarders and paint layers are readily included in simulations. The model accounts for convective moisture transfer by including air cavities which may be coupled to indoor and outdoor air. In this report, the model MOIST is used to investigate the viability of three moisture-control practices in cold climates and hot and humid climates.

13. Investigation of the Mechanical Properties of Red Oak 2 by 4's

Green, David W.; McDonald, Kent A.

1993. *Wood Fiber Sci.* 25(1): 35–45.

The primary objective of this study was to show that relationships between mechanical property values for structural lumber produced from northern red oak are similar to those found for softwood species. A secondary objective was to evaluate potential increases in allowable property values of nominal 2- by 4-in. (standard 38- by 89-mm) red oak lumber that might result from basing allowable property values for visually graded lumber on tests of full-size lumber.

Monitoring Tensile Strength of End-Jointed Lumber Using Ultrasonics

Han, M.B.; Bender, D.A.; Ross, R.J.; Bray, D.E.

1992. Presented at American Society of Agricultural Engineers Meeting; 1992 December 15–18; Nashville, TN. Paper No. 924546. 18 p.

Available from American Society of Agricultural Engineers, 2950 Niles Road, St. Joseph, MI 49085–9659. Cost: ASAE member \$5; nonmember \$6.50, plus shipping \$3.50.

Nondestructive evaluation techniques are needed to improve quality control of structural end-jointed lumber. Ultrasonic wave characteristics were measured across end joint profiles over a variety of sensor locations and excitation frequencies. Key ultrasonic features were extracted and multivariate statistical models were developed to predict tensile strength.

14. Performance of Red Maple Glulam Timber Beam

Manbeck, Harvey B.; Janowiak, John J.; Blankenhorn, Paul R.; Labosky, Peter; Moody, Russell C.; Hernandez, Roland. 1993. USDA Forest Serv. Res. Pap. FPL–RP–519. 30 p.

The objectives of the research were (a) to develop a red maple glulam timber beam combination with a target bending design stress level, (b) to establish the technical basis for developing allowable properties for bending strength and MOE of red maple glulam beams, and (c) to determine if calculation procedures outlined in the American Society for Testing and Materials can be used to predict bending strength and stiffness of red maple glulam beams.

15. Moisture—A Critical Element in Duration-of-Load/Creep Research

McNatt, J. Dobbin.

1993. Proceedings of the 1993 Structural Board Association Workshop; 1993 February 16–18; Toronto, Ontario, Canada. 7 p.

This paper discusses the importance of considering the effects of moisture and the interaction of moisture and mechanical loading when planning research on duration of load/creep of wood-based materials. Selected published literature on this subject is summarized, and moisture exposure recommendations are presented.

16. Selected Properties of Commercial High-Density Hardboards

McNatt, J. Dobbin; Myers, Gary.

1992. *Forest Prod. J.* 43(4): 59–62.

The objectives of this study were to compare property values of high-density hardboards produced today with those from the 1960s hardboard study and with property requirements of the American National Standards Institute.

17. Yellow Poplar Glulam Timber Beam Performance

Moody, Russell C.; Hernandez, Roland; Davalos, Julio F.; Sonti, Somnath Sharma.

1993. USDA Forest Serv. Res. Pap. FPL-RP-520. 28 p.

The objectives of this study were to develop and verify a basis for a specification for Yellow Poplar glulam timber. A total of 45 glulam timber beams were manufactured and evaluated. In addition, more than 200 end-jointed lumber specimens were tested in tension to compare individual specimen performance to full-size beam performance.

18. Nondestructive Evaluation of Wood—Past, Present, and Future

Ross, Robert J.; Pellerin, Roy F.

1990. Nondestructive characterization of materials IV. Ruud, C.O. and others, eds. Proceedings, 4th international symposium on nondestructive characterization of materials; 1990 June 11–14, Annapolis, MD: 59–64.

The purpose of this paper is to provide a brief overview of the evolution of nondestructive testing tools for the forest products industry by reviewing fundamental concepts and pioneering research efforts related to nondestructive testing of wood, presenting two current industrial applications of nondestructive testing, and examining current research activity that will serve as a basis for future applications.

Modeling Response Under Aggressive Environments and Accelerated Testing

Schaffer, E.L.

1992. Special Lecture No. 1. In: Proceedings of 2d CIB/W18B International Conference on Tropical and Hardwood Structures, Kuala Lumpur, Malaysia. 9 p.

Available from General Secretariat, International Council for Building Research Studies and Documentation (CIB), Kruisplein 25 g, 3014 DB Rotterdam, The Netherlands. Contact General Secretariat for cost.

As a result of this study, researchers conclude that a linear damage accumulation model similar to that often applied to predict duration-of-load effects on wood load-carrying capacity could be applied to fire-retardant-treated material. The research effort continues in developing serviceability prediction methods using the model but accounting for cyclic service conditions.

19. Seismic Performance of Low-Rise Wood Buildings

Soltis, Lawrence A.; Falk, Robert H.

1992. Shock Vibr. Dig. 24(12): 3–6.

This article updates a previous literature review paper on the performance of wood-frame buildings during earthquakes and summarizes recent research related to understanding seismic behavior of low-rise wood buildings.

20. Static Strength of Simulated Ceiling and Floor Connections in Modular or Manufactured Housing

Soltis, Lawrence A.; Nelson, William; Winistorfer, Steve G. 1993. Forest Prod. J. 43(4): 11–18.

Objectives of this study were to determine baseline joint property data and compare the strength of joints with gypsum, carpet, or floor tile filler materials to the baseline data. Comparisons were made between lateral, withdrawal, and compressive joint strength values.

21. Effect of Cavity Ventilation on Moisture in Walls and Roofs

TenWolde, A.; Carll, C.

1992. In: Thermal performance of the exterior envelopes of buildings 5. Proceedings of the ASHRAE/DOE/BTECC conference; 1992 December 7–10; Clearwater Beach, FL. Atlanta, GA: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.: 555–562.

This paper discusses the merits of wall and roof cavity ventilation, illustrating it with an example of wall ventilation in manufactured houses. Simple equations are presented to calculate approximate drying or wetting potential in a cavity as a function of cavity ventilation rate and exfiltrative or infiltrative airflow.

22. Properties Related to Drying Defects in Red Oak Wetwood

Verkasalo, Erkki; Ross, Robert J.; TenWolde, Anton; Youngs, Robert L.

1993. USDA Forest Serv. Res. Pap. FPL-RP-516. 10 p.

This study had two objectives: (a) to show the potential of using moisture content, green and basic density, stress wave travel time, and tensile strength across the grain as indicators of bacterial infection in green lumber and (b) to evaluate the relative susceptibility of infected and uninfected lumber to checking during drying and the level of actual drying degrade. Bacterially infected and uninfected green, flat-sawn, 1-1/8-in.-thick red oak (*Quercus* spp.) lumber was used in this study.

23. Mechanical Fasteners in Wood

Winistorfer, Steve G.

1992. Fastener Technol. Int. 15(6): 39–41.

This report focuses on the design procedures and materials of timber connections that use nails, screws, and bolts.

24. Development of a Six-Year Research Needs Assessment for Timber Transportation Structures

Wipf, Terry J.; Ritter, Michael A.; Duwadi, Sheila Rimal; Moody, Russell C.

1993. USDA Forest Serv. Gen. Tech. Rep. FPL-GTR-74. 44 p.

This report summarizes research needs determined and prioritized by public and private individuals, and groups and organizations that have a potential interest in bridges and transportation structures. These research needs are categorized into research areas that correspond to the categories identified in the Intermodal Surface Transportation Act of 1991, Section 1039(a). The projects and priorities identified in this study will be used by the Federal Highway Administration and the USDA Forest Service, Forest Products Laboratory as a basis for developing a national 6-year research program for timber transportation structures.

25. North American Structural Performance Tests of Low-Rise Wood-Frame Building Systems

Wolfe, Ronald W.; Moody, Russell C.

1992. In: Gupta, Ajaya Kumar; Moss, Peter James, eds. Full-scale behavior of wood-framed buildings in earthquakes and high winds. Proceedings of a workshop; 1991 August 28–30; Watford, UK. Raleigh, NC: North Carolina State University: 22–1–22–19.

The purpose of this paper is to summarize test results for low-rise building subassemblies and systems. This summary is intended to serve as a basis for evaluating the strengths and weaknesses of these buildings and for evaluating the adequacy of innovative design alternatives. Computer models developed to predict assembly behavior may be verified or refined on the basis of these results. This summary will also provide a basis for judging where research effort is needed in order to permit characterization of assembly response to all anticipated loads.

26. Stiffness and Strength Properties of Shear Transfer Plate Connections

Wolfe, Ronald; Bohnhoff, David; Nagel, Robert.
1993. USDA Forest Serv. Res. Pap. FPL-RP-517. 25 p.

The purpose of this study was to obtain information about the structural performance of shear transfer plate joints and their sensitivity to fabrication methods, material properties, and test-boundary conditions.

27. Reliability of Bolted Wood Connections

Zahn, John J.
1992. J. Struct. Eng. 118(12): 3362-3376.

In this paper, the results of the reliability assessment of bolted connections are presented. In addition, a comparison of the reliability of the load- and resistance-factor design code and the 1991 National Design Specifications code with current practice is presented.

Fiber and Particle Products

1992 Yearbook of Agriculture

1992. In: New crops, new uses, new markets. 1992 Yearbook of Agriculture. Washington, DC: U.S. Department of Agriculture.

28. New Products From Field and Forest

Youngquist, John; Rowell, Roger; Dietzman, Debra; Bean, Stan.

This section discusses one class of biomass called lignocellulosics. Lignocellulosics are any substances that contain both cellulose and lignin such as wood, agricultural crops and residues, and grasses. Lignocellulosics are drawing increasing interest as a potential source of new materials and an alternative, renewable resource of familiar products.

29. Improvements in Recycling Wood and Wood-Fiber Products

Laufenberg, Ted; Horn, Richard; Wegner, Ted; Bean, Stan.

This section discusses the recycling research that is being conducted by the USDA Forest Service, Forest Products Laboratory, in Madison, WI.

30. Measurement of Flake Alignment in Flakeboard With Grain Angle Indicator

Geimer, Robert L.; McDonald, Kent A.; Bechtel, Friend K.; Wood, James E.
1993. USDA Forest Serv. Res. Pap. FPL-RP-518. 17 p.

This study showed that a Grain Angle Indicator (GAI), developed for measuring grain angle in lumber, can be used to distinguish flake alignment in the faces of structural three-layer flakeboard. The GAI has the potential to be developed for direct on-line monitoring of flake alignment in three-layer flakeboard production.

31. Mat Environments and Flakeboard Properties Affected by Steam Injection Pressing Variables

Johnson, Stephen E.; Geimer, Robert L.; Kamke, Frederick A.
1993. Forest Prod. J. 43(1): 64-66.

The purpose of this study was to measure internal vapor pressures and temperatures in flakeboard mats during steam injection pressing and relate these environmental conditions to adhesive bonding and board properties.

32. Opportunities for Lignocellulosic Materials and Composites

Rowell, Roger M.
1992. In: Emerging technologies for materials and chemicals from biomass: Proceedings of symposium; 1990 August 26-31; Washington, DC: American Chemical Society. Chapter 2. ACS symposium series 476: 1-27.

This proceedings paper discusses the composition of lignocellulosics, the properties of lignocellulosic composites, the interaction of chemical components, and the future of lignocellulosic composites.

33. Property Enhancement of Wood Composites

Rowell, R.M.
1992. In: Vigo, Tyrone L.; Kinzig, Barbara J., eds. Composite applications—the role of matrix, fiber, and interface. New York: VCH Publishers, Inc. Chapter 14: 365-382.

The majority of research on chemical modification of wood composites has dealt with improving either dimensional instability or biological resistance. This chapter reviews improvements in these properties along with opportunities to improve mechanical properties, fire retardancy, resistance to ultraviolet degradation, and chemical resistance in wood and other lignocellulosic composites.

34. Opportunities for Composites From Recycled Wastewood-Based Resources: A Problem Analysis and Research Plan

Rowell, Roger M.; Spelter, Henry; Arola, Rodger A.; Davis, Phil; Friberg, Tom; Hemingway, Richard W.; Rials, Tim; Luneke, David; Narayan, Ramani; Simonsen, John; White, Don.
1993. Forest Prod. J. 43(1): 55-63.

This report describes the resources available; problems associated with collecting, sorting, cleaning, breakdown, classification, and blending of the recycled resources; and process considerations for forming various types of composites. A framework for research is proposed to utilize biobased resources in the waste stream through the development of technologies that will produce composite products and commodities. Research in these areas can result in new lines of products that are cost effective, designed to meet end-use requirements, and environmentally compatible.

35. Effect of In-Plane Shear Modulus of Elasticity on Buckling Strength of Paperboard Plates

Urbanik, Thomas J.

1992. *Wood Fiber Sci.* 24(4): 381-384.

In previous research, a thin-plate theory was derived for analyzing corrugated fiberboard under edgewise compression and subjected to localized buckling. In this note, buckling formulas for thin paperboard plates characterized by an approximate in-plane shear modulus of elasticity are further generalized to allow for arbitrary levels of shear modulus. The results have applications in the design of paper products made of composite plates.

36. Strength Properties of Wood Composites

Youngquist, J.A.

1992. In: Vigo, Tyrone L.; Kinzig, Barbara J., eds. *Composite applications—The role of matrix, fiber, and interface*. New York: VCH Publishers, Inc. Chapter 15: 383-401.

This chapter explains the elements, properties, and uses of wood composites. Several veneer-based products ranging from structural panels for covering applications to panels for decorative use to components for structural lumber substitutes are discussed.

Fire Safety

37. Data Reduction of Room Tests for Zone Model Validation

Janssens, Marc; Tran, Hao C.

1992. *J. Fire Sci.* 10(6): 528-555.

Compartment fire zone models are based on many simplifying assumptions, in particular that gases stratify in two distinct layers. Because of these assumptions, certain model output is in a form unsuitable for direct comparison to measurements made in full-scale room tests. The experimental data must first be reduced and transformed to be compatible with the model output. In this article, new techniques are described to calculate neutral plane height, vent flow rates, uniform upper and lower layer temperature and interface height from measured temperature profiles. The new calculation procedures conserve mass in the room. The procedures were used for data reduction of a series of eight gas burner calibration room tests. This article discusses the results of one test.

38. Flame Retardancy of Wood: Present Status, Recent Problems, and Future Fields

White, Robert H.; Sweet, Mitchell S.

1992. In: Lewin, Menachem, ed. *Recent advances in flame retardancy of polymeric materials: Proceedings of 3rd annual BCC conference on flame retardance*; 1992 May 19-21; Stamford, CT. Norwalk, CT: Business Communications Company, Inc.: 250-257.

In response to specific and immediate research needs, the USDA Forest Service, Forest Products Laboratory, is conducting several studies that pertain to the present and future status of fire-retardant-treated wood and fire-resistive coatings. These studies include the degradation of FRT plywood, the potential use of fire-resistive coatings to protect wood trusses, and the development of a combined preservative-flame-retardant treatment for wood shingles. This paper summarizes these studies.

Microbial and Biochemical Technology

39. Fungal Enzymes for Lignocellulose Degradation

Cullen, D.; Kersten, P.

1992. In: Kinghorn, J.R.; Turner, G., eds. *Applied molecular genetics of filamentous fungi*. New York: Chapman and Hall. Chapter 4: 100-131.

In this chapter, literature relevant to lignocellulose degradation by filamentous fungi is outlined. The format of the text is organized around substrates of increasing complexity (cellulose, hemicellulose, and lignin) and recent developments are highlighted. Areas where knowledge is sketchy are identified. Except as points of reference, prokaryotic systems are not discussed, and the reader is referred to numerous review articles for additional information.

40. Ligninolysis by a Purified Lignin Peroxidase

Hammel, Kenneth E.; Jensen, Kenneth A., Jr.; Mozuch, Michael D.; Landucci, Lawrence L.; Tien, Ming; Pease, Elizabeth A.

1993. *J. Biol. Chem.* 268(17): 12274-12281.

The lignin peroxidases (LiPs) of white-rot basidiomycetes are generally thought to catalyze the oxidative cleavage of polymeric lignin *in vivo*. However, direct evidence for such a role has been lacking. In this investigation, ¹⁴C- and ¹³C-labeled synthetic lignins were oxidized with a purified isozyme of *Phanerochaete chrysosporium* LiP.

Mycology

41. Interfertility Among Isolates of *Armillaria tabescens* in North America

Darmono, T.W.; Burdsall, H.H., Jr.; Volk, T.J.

1992. *Sydowia*. 42(2): 105-116.

The purpose of this research was to establish whether isolates collected from widely dispersed localities east of the Mississippi River belong to a single biological species by using haploid-haploid hypha confrontations (hap-hap) and vegetative-haploid hypha confrontations (di-mon). Because only isolates from secondary mycelium (from basidioma, rhizomorphs, or mycelium fans) are available in many cases, this study compared the di-mon with hap-hap confrontations to determine the reliability of the di-mon reaction in delimiting this species of *Armillaria*.

42. Immuno-Scanning Electron Microscopic Localization of Extracellular Wood-Degrading Enzymes Within the Fibrillar Sheath of the Brown-Rot Fungus *Postia placenta*

Green, Frederick III; Clausen, Carol A.; Larsen, Michael J.; Highley, Terry L.

1992. *Can. J. Microbiol.* 38: 898-904.

This paper represents attempts to localize extracellular wood-degrading enzymes on the surface of hyphae and extracellular sheaths of the brown-rot fungus *Postia placenta* (Fr.) M. Lars. et Lomb. grown on glass cover slips, using MABs produced to the β -1,4-xylanase fraction from decayed wood blocks using immunogold scanning electron microscopy. The results suggest that these enzymes are localized on fibrillar elements of the sheath structure, on the hyphal surface, and within the soluble sheath matrix.

43. Microfibrillar Cell Wall Extensions in the Hyphal Sheath of *Postia placenta*

Larsen, Michael J.; Green, Frederick III.
1992. Can. J. Microbiol. 38: 905-911.

Evidence is provided for the existence of linear extracellular fibrillar elements in the brown-rot fungus *Postia placenta*. These elements appear as structural components of the hyphal sheath and more closely resemble mycofibrils than fungal fimbriae. This study concluded that mycofibrils are linear structural extensions of the hyphal cell wall. The precise function of mycofibrils in the brown-rot decay process of wood remains to be elucidated.

Processing of Wood Products

44. Grouping Tropical Wood Species and Thicknesses by Similar Estimated Kiln Drying Time Using Mathematical Models

Simpson, William T.

1992. In: Vanek, Manfred, ed. Understanding the wood drying process: A synthesis of theory and practice. Proceedings, 3rd International Union of Forestry Research Organizations (IUFRO) international conference; 1992 August 18-21; Vienna, Austria. Vienna, Austria: IUFRO: 38-44.

This paper describes a mathematical model for grouping species by similar drying times. The goal is to kiln dry so that all species emerge at the same time within set limits of moisture content. The model, which uses previously reported data, incorporates specific gravity, initial moisture content, and thickness as criteria for grouping species based on estimated drying time. The model can be used to calculate drying times and moisture content distributions within multiple-step kiln schedules, followed by calculations to equalize all members of the mixture within final moisture content specifications. The model can also be used to base grouping on green weight density, thus eliminating the need for direct information on specific gravity and initial moisture content.

Pulp, Paper, and Packaging

Proceedings of the 1993 Recycling Symposium

1993. In: Course notes. 1993 February 28—March 1-4; New Orleans, LA. Atlanta, GA: TAPPI Press.

45. Recycling and Wastepaper: Legislative Trends

Alig, Joanne T.

The objectives of this study were to (a) analyze the historical trends in wastepaper recycling laws, (b) examine current issues in recycling legislation that affect wastepaper markets, and (c) make assumptions about the extent of future laws.

46. Long Range Fiber Supply and Demand in North America

Ince, P.J.

In this study, an economic model was developed to explain the evolution of markets and technology in detail within the overall North American pulp and paper sector. In addition to simulating historical trends since the mid-1980s, the model is used to provide long-range forecasts of fiber supply and demand and technological change in the pulp and paper

sector. The model is linked to other USDA Forest Service models of the solid wood product sector (lumber and plywood) and timber stumpage markets.

47. Preliminary Results of Enzyme-Enhanced Versus Conventional Deinking of Xerographic Printed Paper

Jeffries, Thomas; Klungness, John H.; Sykes, Marguerite S.; Rutledge-Cropey, Kathleen.

Xerographic and laser printed papers are difficult to deink using conventional methods. The recycling rate for this paper is less than that for other types of paper, and offices are using more laser printers and photocopiers every year. An alternative to conventional deinking is biological deinking, which uses enzymes to peel away cellulose fibrils, thus removing attached toner particles. The detached ink is then more readily removed by a flotation and washing process. This study compares enzyme deinking to chemical deinking of xerographic printed paper.

48. Restoring Bonding Strength to Recycled Fibers

Minor, James L.; Scott, C. Tim; Atalla, Rajai H.

Most recycled fibers have reduced conformability and interfiber bonding capability relative to that of virgin wood pulp fibers. The extent and reversibility of the reduction is dependent on the original pulp type and on the papermaking process. In this report, we review six general methods of restoring or enhancing fiber strength. Examples are taken from a research study on improving interfiber bonding of dry-fiberized newsprint.

49. Evaluating Methods to Increase the Compressive Strength of Recycled Linerboard

Springer, Edward L.; Klungness, John H.; Spangenberg, Richard J.; Minor, James L.; Tan, Freya.

The compressive strength of handsheets produced by reslushing dried linerboard is significantly less than that of handsheets made from original never-dried pulp. This is also true for tensile and burst strengths. Tensile and burst strengths of reslushed linerboard can be significantly improved by chemical and mechanical treatments. The objective of this study was to determine whether compressive strength could be improved by chemical treatment.

50. Alternative Uses for Wastepaper in Wood-Based Composite Products

Youngquist, John A.; English, Brent W.; Rowell, Roger M.

A reduction is urgently needed in the quantities of industrial and municipal solid-waste materials that are currently being landfilled. Major components of these combined waste streams include wastepaper, waste wood, yard waste, gypsum, and plastics. These materials offer great opportunities as recycled ingredients in wood composites. This report discusses possibilities for manufacturing selected composites from these materials. Methods for producing the composites and the resultant product properties and attributes are described. Research and development needs for maximizing the benefits of using recovered waste materials for composite products are also discussed.

51. Biomechanical Pulping of Loblolly Pine Chips With Selected White-Rot Fungi

Akhtar, Masood; Attridge, Michael C.; Myers, Gary C.; Blanchette, Robert A.
1993. *Holzforschung*. 47(1): 36-40.

This paper reports the results of bench-scale studies of biomechanical pulping of loblolly pine chips treated by selected white-rot fungi in two different bioreactor types.

52. Newsprint From Blends of Kenaf CTMP and Deinked Recycled Newsprint

Horn, Richard A.; Wegner, Theodore H.; Kugler, Daniel E.
1992. *Tappi J.* 75(12): 69-72.

Trials on a pilot-plant paper machine were carried out to determine the suitability of using kenaf chemithermomechanical pulp (CTMP) as a reinforcement pulp in newsprint furnishes containing deinked recycled newsprint. Data indicate that an acceptable newsprint can be produced using a blend of 25 percent kenaf CTMP and 75 percent deinked recycled newsprint. These results suggest that kenaf CTMP fiber can be used as a reinforcement pulp instead of expensive semibleached softwood kraft fiber.

53. Adhesive Contaminants in Secondary Fibre Utilisation

Klungness, John H.
1992. In: *Proceedings, Pira Conference on Paperboard—The Technology and the Future*; 1992 11-12 November; West Midlands, UK.

A variety of adhesive contaminants (stickies) are encountered in wastepapers. To use wastepaper in paperboard production, stickies must be controlled. The properties and control methods of adhesive contaminants are discussed in this paper. Specifically, control methods include furnish selection, improved pulping and deflaking, well-designed screening and cleaning systems, and dispersion or additives to detackify or stabilize stickies, or both. The possible application of a new technology for controlling stickies is also discussed. Also, test methods for measuring contaminants in pulps are reviewed.

54. A ^{13}C NMR Study of Milled Wood Lignins From Hybrid *Salix* Clones

Landucci, Lawrence L.; Deka, Ganesh C.; Roy, D.N.
1992. *Holzforschung*. 46(6): 505-511.

Morphological variations in fast-growing hybrid species such as hybrid poplar (*Populus* spp.) have been known for some time. Differences in wood quality, such as specific gravity, were also reported in *Salix* (willow) clones. Variations in chemical composition and kraft pulping yield among clones of black cottonwood were reported, but whether they are caused by genetic factors is still unknown. The purpose of this study was to critically examine the chemical structure of milled-wood lignin isolated from hybrid *Salix* clones by ^{13}C NMR spectroscopy.

55. Improved Penetration of Pulping Reagents Into Wood

Minor, James L.; Springer, Edward L.
1993. *Paperi ja Puu*. 75(4): 241-246.

This article reports the results of pulping alkaline-pretreated wood with peroxymonosulfuric acid and other acidic oxidative pulping

reagents. Experiments were performed to clarify the mechanism of the alkaline pretreatment.

56. Insulating Pressboard for Electrical Transformers

Myers, Gary C.; Hettwer, Paul F.
1992. *Forest Prod. J.* 43(3): 49-52.

The objective of this investigation was to determine whether high-yield hardwood pulps can be used to produce insulating pressboards with increased strength, greater dimensional stability, and improved dielectric properties when compared to commercial softwood insulating pressboards.

Fourier Transform Raman Spectroscopic Studies of a Novel Wood Pulp Bleaching System

Weinstock, Ira A.; Atalla, Rajai H.; Agarwal, Umesh P.; Minor, James L.; Petty, Chris.
1993. *Spectrochimica Acta*. 49A(5/6): 819-829.

Available from Ira A. Weinstock, Forest Products Laboratory, One Gifford Pinchot Drive, Madison, WI 53705-2398. No charge.

In this article, the use of near-infrared (NIR) Fourier transform (FT) Raman spectroscopy for the study of lignocellulosic materials is discussed. Also, an application utilizing NIR FT-Raman spectroscopy to study a novel chlorine-free process for the bleaching of wood pulps is presented in detail. The new process, still under development, entails the oxidation of residual lignin in wood pulps by vanadium-substituted polyoxometalates, and reoxidation of the reduced polyoxometalates by chlorine-free oxidants such as air, dioxygen, peroxides, or ozone.

Timber Requirements and Economics

57. Historical Price Trends of Nonconiferous Tropical Logs and Sawnwood Imported to the United States, Europe, and Japan

Ingram, C. Denise.
1993. *USDA Forest Serv. Gen. Tech. Rep. GTR-75*. 12 p.

This report reviews historical price trends of nonconiferous and tropical sawlogs and tropical sawnwood imports to several major consuming regions of the world. Data on real prices for imports from Africa, Asia, and Latin America to the United States, Europe, and Japan are presented as a reference for policymakers interested in the relative price movements of tropical wood products. The discussion includes an assessment of the data with particular emphasis on indications of economic scarcity evidenced by increasing real price trends.

58. Determinant Attribute Analysis: A Tool for New Wood Product Development

Trinka, Mark W.; Sinclair, Steven A.; Marcin, Thomas C.
1992. *Wood Fiber Sci.* 24(4): 385-391.

Determinant attribute analysis was employed to identify the physical product characteristics most crucial in the purchase decision process for office furniture substrate materials. The importance of recognizing customer needs in the new product development process is central to the analysis, and the potential of determinant attribute analysis as a powerful tool for this process is demonstrated.

Tropical Wood Utilization

59. Drying Technology Issues in Tropical Countries

Simpson, William T.

1992. In: Proceedings of All-division 5 "Forest Products" International Union of Forestry Research Organizations conference; 1992 August 23-28; Nancy, France. Nancy, France: IUFRO: 497-507.

Drying is one key step in processing wood products. An inability to correctly and efficiently dry wood can be a barrier to utilization. This paper discusses some aspects of drying technology that are particularly relevant to tropical forestry and identify issues and areas where additional research and development may be needed.

Wood Bonding Systems

60. Phenol-Formaldehyde Resin Curing and Bonding in Steam-Injection Pressing. Part II. Differences Between Rates of Chemical and Mechanical Responses to Resin Cure

Christiansen, Alfred W.; Follensbee, Robert A.; Geimer, Robert L.; Koutsky, James A.; Myers, George E.
1993. *Holzforschung*. 47(1): 76-82.

This report presents additional data to validate the use of tan delta area as a measure of cure for aqueous phenol-formaldehyde resole resins precured under essentially dry conditions. Also demonstrated is that such mechanical descriptions of the development of cure can differ greatly from chemical descriptions of cure development as determined by differential scanning calorimetry.

61. Contoured Wood Double Cantilever Beam Specimen for Adhesive Joint Fracture Tests

River, Bryan H.; Okkonen, E. Arnold.

1993. *J. Test. Eval.*, JTEVA. 21(1): 21-28.

The contoured double cantilever beam specimen loaded in cleavage (Mode I) is a powerful and recognized test method for evaluating adhesively bonded metal joints. At the Forest Products Laboratory, we adapted this method to evaluate adhesively bonded wood joints and continually strive to improve the test specimen. This report describes the latest test specimen that is easier to use and provides more consistent and accurate results in comparison with those of previous versions.

62. Adhesives in Building

Vick, C.B.

1992. In: Corish, Patrick J., ed. *Advances in materials science and engineering. Concise encyclopedia of polymer processing applications*. New York: Pergamon Press: 17-21.

This article gives an overall explanation of the process of adhesion, in which a substance makes intimate contact with two surfaces and undergoes physical and chemical changes to bond them together. Also given are the advantages, structural performance, types, and uses of adhesives.

63. Cure of Phenol-Formaldehyde Adhesive in the Presence of CCA-Treated Wood by Differential Scanning Calorimetry

Vick, Charles B.; Christiansen, Alfred W.

1993. *Wood Fiber Sci.* 25(1): 77-86.

This article describes efforts to identify causes for poor adhesion, specifically to determine if metallic ions in chromated copper arsenate-treated wood interfere with the cure of the phenolic adhesive.

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